

have in a very different manner in the sequel of the development: that which has given origin to the female elements disappears immediately afterwards, whilst the vesicle which has generated the male or spermatic elements, far from disappearing, continues its development, often becomes very large, and after forming connexions with the female generative apparatus, constitutes a reservoir for the fecundative corpuscles—becoming, in fact, a true seminal vesicle for this hermaphrodite apparatus.

When the curious phenomena just described summarily have terminated, the embryonic development, properly so-called, has not yet commenced. We may, indeed, observe that the cells of the blastoderm have multiplied at the anterior pole so as to produce a very considerable thickening there; but this modification is not followed by the formation of any new part. This thicker layer, in fact, soon gradually diminishes, and is at last entirely effaced*.

XIII.—On the Reproduction and Embryogeny of the Aphides.

By M. BALBIANI. (Second Note.)†

IN the viviparous *Aphides* the blastoderm assists to a certain extent in the formation of the embryo, but its part is exclusively limited to the production of the laminae which complete the cephalic extremity in front. All the rest, on the contrary, results from an entirely new part superadded to the blastoderm.

The first phenomenon which denotes the commencement of embryonic development is a budding forth of cells upon one of the halves of the circumference of the aperture (of which I have already indicated the purpose and mode of formation) at the posterior pole of the blastoderm. The result of this budding is the production of a cellular lamina, which gradually rises from the margin of the preceding aperture into the interior of the ovum, folding back against the inner wall of the blastoderm, which it appears in some degree to double for a certain extent. When arrived within a short distance of the anterior pole, it folds inwards, inversely to its former direction, as if to descend again towards the aperture which was its point of departure, but without passing, at least at this time, the middle of the ascending

periods of embryonic development and even after birth, has been described sometimes as serving for the nutrition of the embryo (*pseudo-vitellus* of Huxley), sometimes as a plastic mass destined for the formation of the vegetative organs (Leydig).

* This transitory production of the blastoderm of the Aphides is probably the analogue of the "primitive cumulus" described by Claparède as preceding the formation of the embryonal rudiment in the ova of the Spiders.

† Translated from the 'Comptes Rendus,' June 11th, 1866, pp. 1285-1289.

branch. This curved lamina, produced in this way by a budding of the blastoderm in the interior of its own cavity, is nothing but the embryonic rudiment or primitive streak, less the anterior part of the head; in fact the ascending branch represents the whole of the ventral cephalothoracic wall, destined to bear the buccal and locomotive appendages, and the descending branch the ventral wall of the abdomen. As to the elements destined to form the anterior wall of the head with its appendages, or the antennæ, these are, as I have just stated, the only ones which result from a transformation of the blastoderm. For this purpose the latter becomes thickened in the region corresponding with that against which the ascending or cephalothoracic branch of the primitive streak is applied in such a manner as to surround like a hood the base of this branch, with which this thickened part is continued through the orifice of the posterior pole. In all the rest of its extent the blastoderm becomes transformed into a delicate membrane, which envelopes the embryo as it were in a sort of sac, which isolates it from the ovarian chamber.

At this period of its evolution the embryonal streak therefore presents in its totality the form of an S, of which the inferior curvature represents the cephalic hood, the superior curvature the rudiment of the abdomen, and the intermediate branch the combined rudiments of the head and thorax.

The primitive streak divides into two longitudinal halves by the formation of a furrow upon each of its faces. These two symmetrical halves, which represent the axes of the two halves of the body, and betray the bilateral type of the animal, are the germinative tuberosities (*Keimwülste* of the German embryogenists). Their formation is one of the earliest phenomena in the evolution of the *Aphides*; for it takes place *pari passu* with the formation of the primitive streak, and consequently long before the appearance of the zonites and their appendages. As to the other principal embryogenic phenomena, such as the formation of a reflected superficial lamella (the *Faltenblatt* of Weismann), that of the primitive parts of the head, the division of the germinative tuberosities into transverse segments or zonites, the appearance of the cephalic and thoracic appendages, &c., I can only mention them here, leaving all that relates to these different points of embryonic evolution to the memoir in which I propose to treat *in extenso* the subject of which this note gives a summary.

In proportion as the primitive streak penetrates into the interior of the ovum, the sexual masses follow it in its movement, and place themselves against the inner face of the upper reflected or abdominal portion of this streak. At this period nothing yet exists resembling a visceral cavity, the streak, as in all the Arti-

culata, containing only the elements of the head and of the inferior wall of the body. The sexual masses are therefore, in point of fact, completely naked and outside the embryo. But already we can see that the embryonic cells arrange themselves in parallel series directed towards the extremity of the abdomen, to form excretory ducts, destined to place them in relation with that region.

Development continuing under these conditions, the embryo enlarges, and with it the whole sexual apparatus; the parts already existing become completed and perfected, the mouth and anus are formed, and the digestive tube becomes visible at its extremities. It is at this point that a phenomenon occurs equally simple in its mechanism and important in its results for the further progress of the development of the Articulata, namely the reversal of the mode of rolling of the embryo. This reversal, which is not always effected by means of exactly the same process in all these animals, takes place in the *Aphides* by an actual backward summerset executed by the embryo in the interior of its cell. In consequence of this change of position the head, which at first was in relation to the posterior part of the cell, arrives at the anterior part, while the ventral surface, at first turned inwards, now looks outwards, and is placed immediately under the envelope of the egg. By the same act the abdomen is transferred to the dorsal side, and rises, like a sort of tail to the embryo, as far as the posterior part of the head, leaving between it and the cephalothoracic rudiment a space, the greater part of which is occupied by the mass of the generative organs. In this new position all that is necessary is that the embryo should complete itself behind by the formation of a dorsal wall, in order that these organs may be enclosed in the cavity of the body quite naturally and without any new change of position.

The closure of the hinder part of the body is effected by the simple growth of the ventral arches towards the dorsal region, and their fusion in the median line of the latter.

If we endeavour at this period of development to understand the arrangement of the hermaphrodite apparatus of the viviparous *Aphides*, we find the primitive common mass of ovarian cells divided into two groups, symmetrically placed in the posterior part of the body, and each of these groups formed of a small number of cellular masses, each of which possesses a proper envelope. In these we easily recognize the terminal chambers of the ovarian sheaths, with their contents, consisting of small transparent cells. The male organ is likewise divided into two parts, arranged, in the form of two cords of variable form, on each side of the digestive tube, within the ovaries,

above which they rise more or less. The whole mass of these organs, the green colour of which being often very intense immediately catches the eye, is composed of large oval or polyhedral cells, the characters of which I shall describe further on, in speaking of the formation of the seminal corpuscles. A very delicate envelope extends itself round each of them, and is continued to the posterior part in an attenuated process, which loses itself upon the sides of the rectum, and probably represents an excretory duct. As the neck of the seminal vesicle may likewise be followed into this region, it is probably there that the union of these ducts with the spermatic reservoir is effected. As to the seminal vesicle, it is formed by a sac of considerable size situated on the median line above the intestine, with its fundus sometimes advancing nearly to the middle of the body. Its wall is formed by a simple structureless membrane, a true cell-membrane, of such delicacy and transparency that in most cases its presence is betrayed only by the seminal corpuscles and coloured granulations composing its contents—which explains how it has remained undetected by all observers. The seminal vesicle terminates by a very slender duct, which represents its neck, and which I have been able to trace to the point of union of the two ovarian tubes, where it is probably inserted.

It remains for me, in conclusion, to say a few words about the spermatic corpuscles and their formation. This commences very early; for all the embryos of the viviparous *Aphides* at the moment of their birth contain new generations in course of development. Still more, it is not rare to find the spermatic reservoir, to the early formation of which I have adverted above, already filled with seminal corpuscles before there is any trace of an embryo in the ovum. These corpuscles are formed, as I have already stated, in the large coloured cells which constitute the mass of the two organs situated in the vicinity of the ovaries. At the moment of their appearance these cells contained only a homogeneous and colourless substance; but as they enlarge they become penetrated by fine granules, which give them the green or yellowish-green colour presented by them in most *Aphides*; at the same time their contents become converted into a multitude of little daughter cells, furnished with a membrane and a nucleus: these are the cells of development of the spermatic elements. They are, in fact, soon replaced by innumerable small dark corpuscles of 0.001–0.002 millim. in diameter, which, under a strong power, appear like minute *Amœbæ*; but their form does not change under the microscope. The large mother cells have then lost their transparency and their green colour, and become opaque and brownish; they are easily disintegrated, breaking up into a sort of powder after the destruction of their

enveloping membrane. In many *Aphides* these Amœboid corpuscles undergo a further degree of evolution by their transformation into small unequal bacilli, which are straight or diversely flexuose, immobile and colourless, and 0·005–0·020 millim. in length. We might easily be led to regard them as a parasitic vegetable production, if we had not before our eyes all the successive phases of the transformation of these elements. Moreover their rapid solubility in alkaline solutions constitutes a character which differentiates them completely from the microscopic *Oscillatoria*, with which they present the greatest resemblance. Several times I have succeeded in seeing some of these corpuscles in the ovarian tubes, or forming small groups at the bottom of the terminal chamber of the ovigerous sheaths.

In the third and last part of this memoir I shall investigate the phenomena of reproduction in the oviparous *Aphides*, and show how these are related to the viviparous generations which preceded them.

MISCELLANEOUS.

On the Metamorphoses of the Marine Crustacea.

By M. Z. GERBE.

THE author gives the following summary of the conclusions to which his investigations have led him:—

1. The larvæ of the species belonging to the genera *Maia*, *Pisa*, *Platycarcinus*, *Cancer*, *Xantus*, *Gonoplax*, *Portunus*, *Porcellana*, *Palinurus*, *Homarus*, *Callinassa*, *Crangon*, *Athanas*, *Palæmon*, *Mysis*, *Ione*, and very probably those of many other genera, undergo, immediately after their birth, a first moult, which gives them a form different from that which they possessed in the egg.

2. None of the marine Crustacea of the division Podophthalma, or of the Edriophthalma, which I have observed has its organization complete at birth or possesses forms by which it might be referred to the species to which it belongs, and all are furnished with transitory appendages for natation, which give them a locomotion different from that which they will have in the perfect state: these appendages persist until the fifth or sixth moult, and become atrophied in position without falling off.

3. It is only at the fifth moult in some, and at the sixth in others, and after having undergone modifications at each moult, that the general form of the adult and the external organs are complete. To these transitory external forms, so different from those of the perfect animals, and becoming modified at each moult, are due a multitude of false species and genera and doubtful families*, and even, as regards the larvæ of the *Palinuri*, an entire order to be eliminated.

* The family of the Erichthidæ, in the order Stomapoda, appears to me to be chiefly founded upon Crustacea in the larval state.